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EXAMINER	
PERILLA, JASON M	
ART UNIT	**PAPER NUMBER**
2634	3

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Please find below and/or attached an Office communication concerning this application or proceeding.

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Office Action Summary	Application No.	Applicant(s)	
	09/614,784	KANDALA ET AL.	
	Examiner	Art Unit	
	Jason M Perilla	2634	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *12 July 2000*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-25* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-25* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *12 July 2000* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *2*.
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

1. Claims 1-25 are pending in the application.

Specification

2. The abstract of the disclosure is objected to because it is composed of more than a single paragraph. Correction is required. See MPEP § 608.01(b).

Claim Objections

3. Claim 1, lines 2 and 5 recite the limitation "said demodulated signal". There is insufficient antecedent basis for this limitation in the claim.

4. Claim 1, line 7 recites the limitation "said at least one proximate constellation vector". There is insufficient antecedent basis for this limitation in the claim.

5. Claim 2, line 11 recites the limitation "said corresponding phase component". There is insufficient antecedent basis for this limitation in the claim.

6. Claim 3, line 2 recites the limitation "said proximate constellation". There is insufficient antecedent basis for this limitation in the claim.

7. Claim 5, line 3 recites the limitation "said signal". There is insufficient antecedent basis for this limitation in the claim.

8. Claim 10, lines 3, 8 & 11 recite the limitation "said acquired signal`". There is insufficient antecedent basis for this limitation in the claim. The use of "said acquired signal" in child claims 11-16 of parent claim 10 are further lacking antecedent basis. Appropriate correction (i.e. said acquired multi-level modulated signal) is required.

Claim Rejections - 35 USC § 102

9. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

10. Claims 1-16 are rejected under 35 U.S.C. 102(e) as being clearly anticipated by Harada et al (6115435).

Regarding claim 1, Harada et al discloses a method of demodulating a multilevel signal comprising the steps of assigning a value to a bit representing the demodulated signal, identifying at least one signal constellation vector proximate to the multilevel signal, and determining a reliability measure of the demodulated bit if the bit occupies a bit position of a constellation vector occupied by a bit of a varying value. Harada et al discloses a method of demodulating multilevel QAM signals (fig. 4; col. 1, line 55). Values are assigned to bits representing the demodulated signal (fig. 4, ref. a-c). At least one signal constellation vector proximate to the multilevel signal is identified, and a reliability measure of the demodulated bit is found if the demodulated bit occupies a bit position of a constellation occupied by a bit of a varying value. Note the constellation vectors of figure 4 referenced by their four bit binary values (ref. "1000", "1010",...). A reliability measure is taken depending on the neighborhood that the demodulated bit occupies (col. 1, line 48; col. 3, line 63).

Regarding claim 2, Harada et al discloses a method of demodulating a multilevel signal comprising the steps of assigning a value to a bit representing the demodulated signal, identifying at least one signal constellation vector proximate to the multilevel signal, and determining a reliability measure of the demodulated bit if the bit occupies a bit position of a constellation vector occupied by a bit of a varying value as applied to claim 1 above. Further, Harada et al discloses the step of identifying at least one signal constellation vector proximate to said multilevel signal comprising the steps of determining a first and second phase component of the multilevel signal, identifying a constellation vector having a first and a second phase component of maximized absolute value but not exceeding an absolute value of the components of the multilevel signal, identifying any constellation vector having one phase component of maximized value but not exceeding the value of the corresponding component of the multilevel signal and another phase component of minimized absolute value but not less that the corresponding component of the multilevel signal, and identifying any constellation vector having phase components of minimized absolute value but not less than the corresponding components of the multilevel signal. Note the several neighborhoods (ref. A-Y) that may are shown in figure 4 depending on the bit representing the multilevel signal and the constellation vectors (ref. "1000", "1010",...). The appropriate constellation vector(s) and neighborhood are identified by determining the phase components of the bit representing the multilevel signal (ref. a-c), and then choosing the constellation vectors according to the bit as described by the limitations of the claim

above and shown in figure 4. A description of the choice of the constellation vectors is provided (col. 3, line 62).

Regarding claim 3, Harada et al discloses the limitations of claims 1 and 2 as applied above. Harada et al also discloses the method of claim 2 further comprising the step of identifying a center of gravity equal distant from the proximate constellation vectors and having first and second center of gravity phase coordinates. Figures 5-7 show the identification of a different center of gravity for various neighborhoods. Figure 5 shows a center of gravity having first and second phase coordinates (intersection of soft decision axes) for the neighborhood "I" in Figure 4.

Regarding claim 4, Harada et al has disclosed the limitations of claim 3 as applied above. Harada et al also discloses that the measure of reliability is a function of the difference between at least one of the first and second phase components of a bit representing the multilevel signal and the center of gravity phase coordinates (fig. 5; col. 4, line 3).

Regarding claim 5, Harada et al discloses a method of demodulating a multilevel signal comprising the steps of identifying a neighborhood of a signal constellation in proximity to the signal being defined by a set of at least one constellation signal, assigning a hard decision value to a bit of said demodulated signal if it occupies a bit position corresponding to a constant bit value, determining a center of gravity of the neighborhood, and assigning a value and reliability measure to a demodulated signal bit if it occupies a position having a variable bit value. Figure 4 shows the definitions of various neighborhoods depending on the demodulated bit. The demodulated signal "a"

of figure 4 has a corresponding neighborhood "I" defined by a set of constellation vectors "0010", "0000", "0011", and "0001". Likewise, the demodulated signal "c" of figure 4 has a corresponding neighborhood "K" defined by a set of constellation vectors "1001", and "1101". A hard decision or absolute decision is made for bit(s) of the demodulated signal that are constant for a particular neighborhood. It is recited that the bits "y3" and "y2" of the demodulated signal "a" of figure 4 are found by hard decision to be both "0" (col. 4, line 3). A center of gravity is determined for the neighborhood. For the neighborhood "I" of figure 4, the determined center of gravity is shown in figure 5 (col. 4, line 11). A value and a reliability measure is assigned to the bits of a neighborhood that are of a varying value. For the demodulated signal "a" of figure 4, a reliability measure for bits "y1" and "y0" is obtained for each since the bits are varying within the neighborhood "I" (col. 4, line 7). A value is assigned to any bits of varying values within a neighborhood using the reliability measure (col. 7, line 31).

Regarding claim 6, Harada et al discloses the limitations of claim 5 as applied above. Harada et al further discloses that the reliability measure is a function of a relative position of the multilevel signal and a center of gravity of a neighborhood. Figure 5 shows the demodulated signal "a" and the reliability measure being a function of the relative position of the demodulated signal "a" and the center of gravity (intersection of axes) of the neighborhood (col. 4, line 7).

Regarding claim 7, Harada et al discloses the limitations of claim 5 as applied above. Harada et al further discloses that the reliability measure is a distance between a multilevel signal and a center of gravity of a neighborhood (fig. 5; col. 4, line 7).

Regarding claim 8, Harada et al discloses the limitations of claim 5 as applied above. Harada et al further discloses that the reliability measure comprises a difference between a quadrature component of a multilevel signal and a quadrature component of a center of gravity of a neighborhood (fig. 5; col. 4, line 7).

Regarding claim 9, Harada et al discloses the limitations of claim 5 as applied above. Harada et al further discloses that the reliability measure comprises a difference between an in-phase component of a multilevel signal and an in-phase component of a center of gravity of a neighborhood (fig. 5; col. 4, line 7).

Regarding claim 10, Harada et al discloses a method of demodulating a signal comprising the steps of acquiring the multilevel modulated signal, locating the acquired signal relative to a constellation of signal vectors being represented by a plurality of bits, identifying a plurality of signal vectors defining a neighborhood of the constellation nearest the acquired signal, determining the center of gravity of the neighborhood, assigning a hard decision value to a bit representing the acquired signal if a corresponding bit is constant for the signal within the defining neighborhood, and assigning a soft decision value and a measure of reliability of a bit representing the acquired signal if a corresponding bit is varying for the signal within the defining neighborhood. Figure 4 shows various acquired multilevel signals (ref. a-c) and it shows a plurality of signal vectors each being represented by a plurality of bits. For instance, the neighborhood "A" of figure 4 is defined by the signal vector represented by the plurality of bits "1000". Figure 4 also shows the identification of a neighborhood ("I") defined by a plurality of signal vectors nearest the acquired signal ("a"). Bit values are

defined by a hard decision for any bits of an acquired signal that are constant within a corresponding neighborhood (col. 4, line 3). Bit values and a reliability measure are defined by a soft decision of any bits of an acquired signal that are varying within a corresponding neighborhood (col. 4, line 7; col. 7, line 31).

Regarding claim 11, Harada et al discloses the limitations of claim 10 as applied above. Harada et al further discloses assigning a value to a bit representing an acquired signal if its corresponding neighborhood is defined by a single vector. The neighborhood "E" of figure 4 is defined by a single vector represented by the bits "0000". Harada et al discloses that an acquired signal that has a corresponding neighborhood represented by "E" of figure 4 would be assigned a bit value "0000" by hard decision (col. 4, line 28).

Regarding claim 12, Harada et al discloses the limitations of claim 10 as applied above. Harada et al further discloses the reliability measure being a function of a relative position of an acquired signal and the center of gravity of the neighborhood. Figure 5 shows how the reliability measure is a function of the relative position of the acquired signal "a" and the center of gravity (center of axes) and it is also described (col. 4, line 7).

Regarding claim 13, Harada et al discloses the limitations of claim 10 as applied above. Harada et al further discloses the reliability measure being distance between an acquired signal and the center of gravity of the neighborhood. Figure 5 shows how the reliability measure is a distance between the position of the acquired signal "a" and the center of gravity (center of axes) and it is also described (col. 4, line 7).

Regarding claim 14, Harada et al discloses the limitations of claim 10 as applied above. Harada et al further discloses that the reliability measure comprises a difference between a quadrature component of a multilevel signal and a quadrature component of a center of gravity of a neighborhood (fig. 5; col. 4, line 7).

Regarding claim 15, Harada et al discloses the limitations of claim 10 as applied above. Harada et al further discloses that the reliability measure comprises a difference between an in-phase component of a multilevel signal and an in-phase component of a center of gravity of a neighborhood (fig. 5; col. 4, line 7).

Regarding claim 16, Harada et al discloses the limitations of claim 10 as applied above. Harada et al further shows the constellation of signals vectors in figure 4 ordered according to gray code.

11. Claims 23-25 are rejected under 35 U.S.C. 102(b) as being anticipated by Viterbi et al (IEEE Transactions on communications, Vol. 41, No. 4, April 1993).

Regarding claim 23, Viterbi et al discloses a method of demodulating a multilevel signal comprising limiting a measure of reliability to a predetermined range (pg. 562, col. 2, line 7) and providing a soft decision value to bits of the demodulated signal associated a measure of reliability having values not exceeding a limiting value of the range (pg. 561, col. 2, line 8).

Regarding claim 24, Viterbi et al discloses a method of demodulating a multilevel signal comprising limiting a measure of reliability to a predetermined range and providing a soft decision value to bits of the demodulated signal associated a measure of reliability having values not exceeding a limiting value of the range as applied to claim

23 above. Viterbi et al further discloses the measure of reliability being a log likelihood ratio (pg. 562, col. 1, line 12).

Regarding claim 25, Viterbi et al discloses a method of demodulating a multilevel signal comprising limiting a measure of reliability to a predetermined range and providing a soft decision value to bits of the demodulated signal associated a measure of reliability having values not exceeding a limiting value of the range as applied to claim 23 above. Viterbi et al further discloses that the limiting range is equivalent to a number of bit demodulated with a soft decision (pg. 562, col. 2, line 7).

Claim Rejections - 35 USC § 103

12. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

13. Claims 17-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Harada et al in view of Viterbi et al.

Regarding claim 17, Harada et al discloses a method of demodulating a multilevel signal using a Viterbi decoder (fig. 14, ref 341; col. 7, line 31). Harada et al does not disclose the Viterbi decoder comparing the reliability of at least two bits of the demodulated signal, assigning a hard decision to a bit associated with a greater reliability, and assigning a soft decision to a bit associated with a lesser reliability. However, Viterbi et al discloses a decoder that compares the reliability of at least two bits, assigns hard decision values to bits associated with greater reliability, and assigns

soft decision values to bits associated with lesser reliability depending on their log likelihood ratio (pg. 561, col. 1, III. Signal Statistics, Metric Calculation, and Soft Decoder Performance). Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to utilize the Viterbi decoder of the exemplary description by Viterbi et al for the Viterbi decoder shown by Harada et al.

Regarding claim 18, Harada et al in view of Viterbi et al disclose a method of demodulating a multilevel signal comprising comparing the reliability of at least two bits of the signal, assigning a hard decision value to a bit associated with a greater reliability, and assigning a soft decision value to a bit associated with lesser reliability as applied to claim 17 above. Viterbi et al further discloses that the reliability is measured by a log likelihood ratio (pg. 562, col. 1, line 13).

Regarding claim 19, Harada et al in view of Viterbi et al disclose a method of demodulating a multilevel signal comprising comparing the reliability of at least two bits of the signal, assigning a hard decision value to a bit associated with a greater reliability, and assigning a soft decision value to a bit associated with lesser reliability as applied to claim 17 above. Harada et al further discloses the steps of assigning a soft decision value to bits of the demodulated multilevel signal comprising assigning a value to the bit (col. 7, line 31) and assigning a measure of reliability to the bit (col. 4, line 7).

Regarding claim 20, Harada et al in view of Viterbi et al discloses the limitations of claim 19 as applied above. Further, Viterbi et al discloses that the measure of reliability is a log likelihood ratio (pg. 562, col. 1, line 13).

Regarding claim 21, Harada et al in view of Viterbi et al discloses the limitations of claim 17 as applied above. Viterbi et al further discloses the limiting the measure of reliability to a predetermined range (pg. 562, col. 2, line 7) and providing a soft decision value to bits of the demodulated multilevel signal associated a measure of reliability having values not exceeding a limiting value of the range (pg. 562, col. 1-2).

Regarding claim 22, Harada et al in view of Viterbi et al discloses the limitations of claim 21 as applied above. Viterbi et al further discloses that the limiting value of the range is equivalent to the number of bits demodulated with a soft decision (pg. 562, col. 2).

Conclusion

14. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

The following prior art references are cited to further show the state of the art with respect to hybrid decision demodulation:

U.S. Pat. No. 6243423 to Sakoda et al; maximum likelihood demodulator

U.S. Pat. No. 5432818 to Lou; maximum likelihood demodulator

15. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jason M Perilla whose telephone number is (703) 305-0374. The examiner can normally be reached on M-F 8-5 EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Steven Chin can be reached on (703) 305-4714. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 306-0377.

Jason M Perilla
September 23, 2003

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